DELAY PRINCIPLES BASED ON COMPLETION RISK

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LIMITATIONS OF TRADITIONAL CPM SCHEDULING AND DELAY ANALYSES

Deterministic schedules are not the best tool available for modeling, forecasting, and managing projects.

Traditional CPM scheduling makes unrealistic assumptions when dealing with delay.

A COMPLETELY NEW PARADIGM: PROBABILISTIC PLANNING AND DELAY ANALYSES

The technology of statistically simulating alternative schedule outcomes and generating the probability of completion on any given date is a more realistic way of forecasting project completion.

HOW RISKED SCHEDULES ARE TYPICALLY USED

as a diagnostic tool prior to project start in order to assess the probability of completion by a certain date.

to make changes to the schedule in order to increase the probability of completion by a certain date.

WHAT WE ARE PROPOSING

A theoretical framework to measure delay based on completion risk in a schedule that is risk assessed initially and periodically updated throughout the project life cycle.

Simulation techniques are used to analyze the underlying uncertainties within each activity and resulting critical path(s).

DEFINITIONS

Deterministic Schedule – A schedule that has 1 duration assigned to each activity, a static critical path or paths, and an end date.

DEFINITIONS

Risked Schedule – A schedule that has been evaluated by stakeholders and risk subject matter experts. The schedule will have ranges of possible durations applied to most activities. Then the schedule is simulated using Monte Carlo or other statistical tools in order to estimate the probabilities of the possible completion dates.


Invented by Stanislaw Ulam and John von Neumann
Named after the famous “odds based” casino city in the Principality of Monaco

LATIN HYPERCUBE

Invented later (1979)

More efficient than Monte Carlo

DEFINITIONS

Criticality Index: number of realizations that an activity falls on the longest path as a ratio to the total number of realizations; statistical measure of the probability the activity falls on the stochastic longest path.

HOW DOES THIS APPLY TO DELAY?

When analyzing delay in a deterministic schedule, delays which do not impact the critical path do not delay the project. However, when analyzing delay in a risked schedule a delay off the critical path may create scenarios in which the project is delayed depending on the criticality index of the activity(s) delayed.

DELAY ANALYSIS USING DETERMINISTIC SCHEDULE

Where the approach to project scheduling is deterministic, the critical path is deemed to be certain. This assumption gives rise to the following conventional delay principles (Ponce de Leon et al. 2010):

A delay off the critical path *within the* total float does not impact schedule completion.

A delay on the critical path equates to a day-per-day delay in schedule completion.

A contractor delay on the critical path may be construed as reasonable evidence of a potential contract breach, possibly justifying withholding liquidated damages.

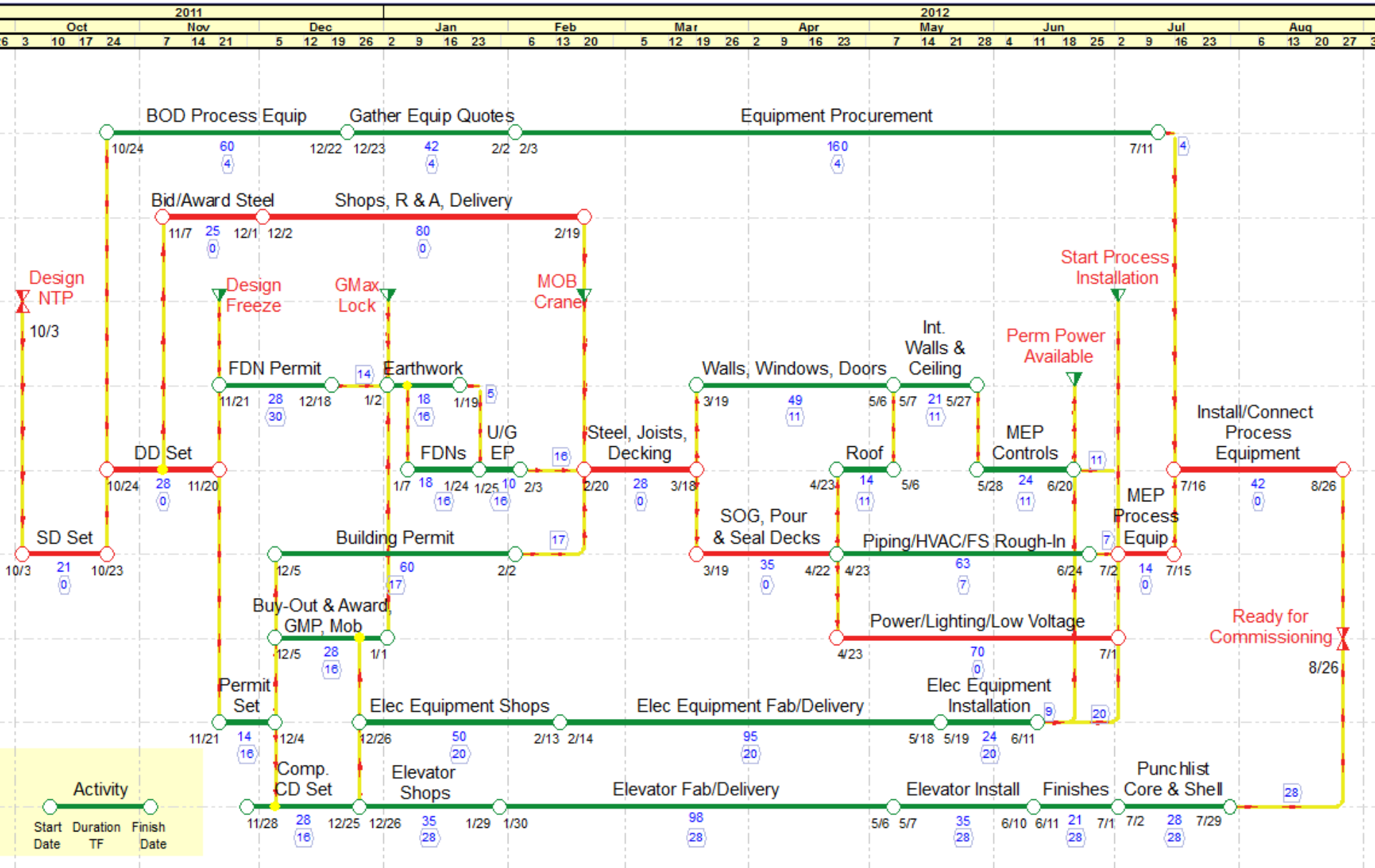
DELAY ANALYSIS IN A RISKED SCHEDULE

Risk in project scheduling aligns better with the concept of completion risk. Rather than a yes/no proposition, likelihood of impact is front and center:

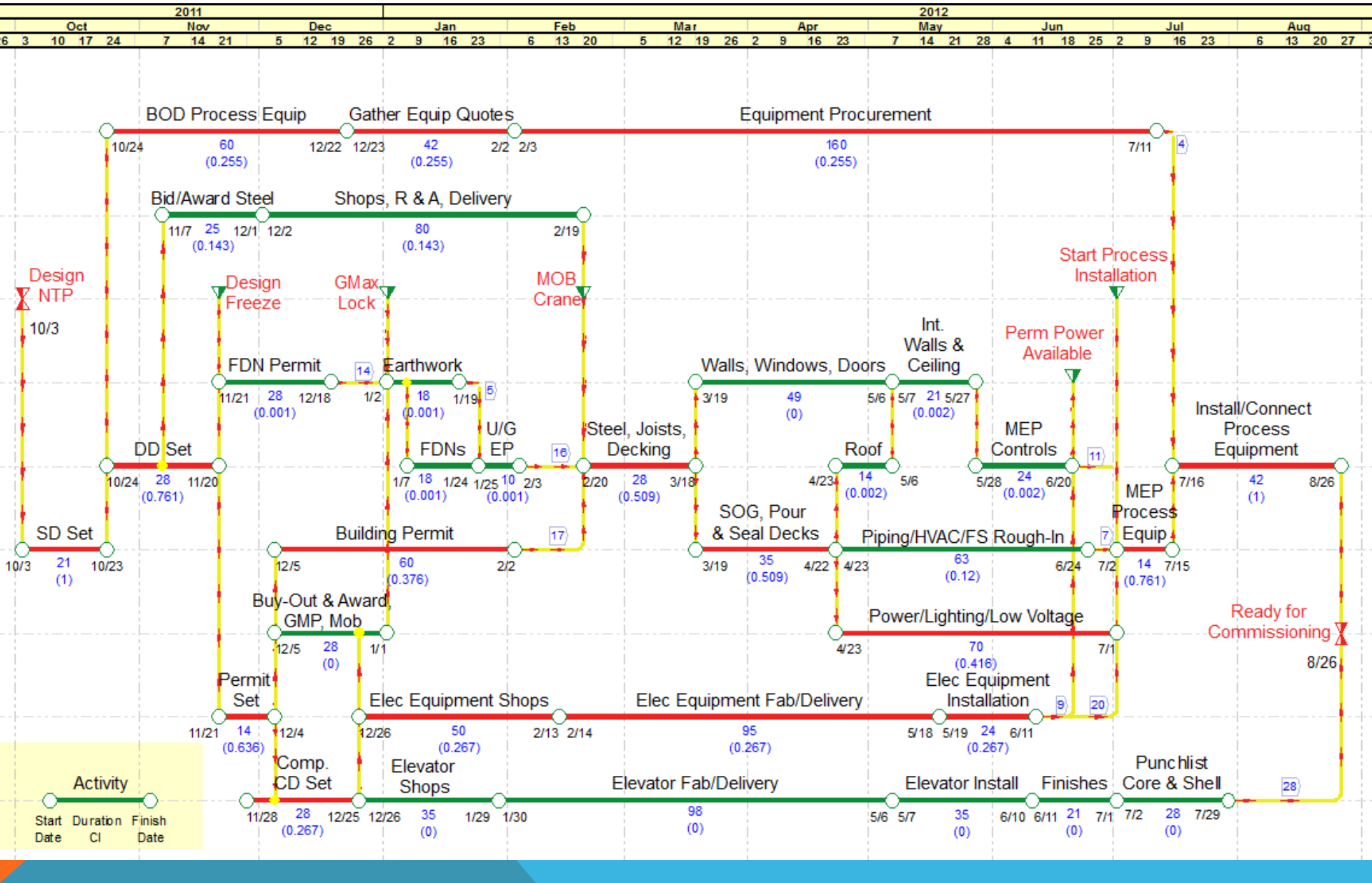
The likely impact of a delay on completion risk is based on the criticality indices then existing (which reflect the status of the schedule and current risk parameters) when the delay occurs.

The likely impact of a delay on the required completion date can be determined through an approach that compares (a) the probability of completing on time for the impacted schedule to (b) the probability of completing on time for a *but-for* schedule scenario that removes the delay.

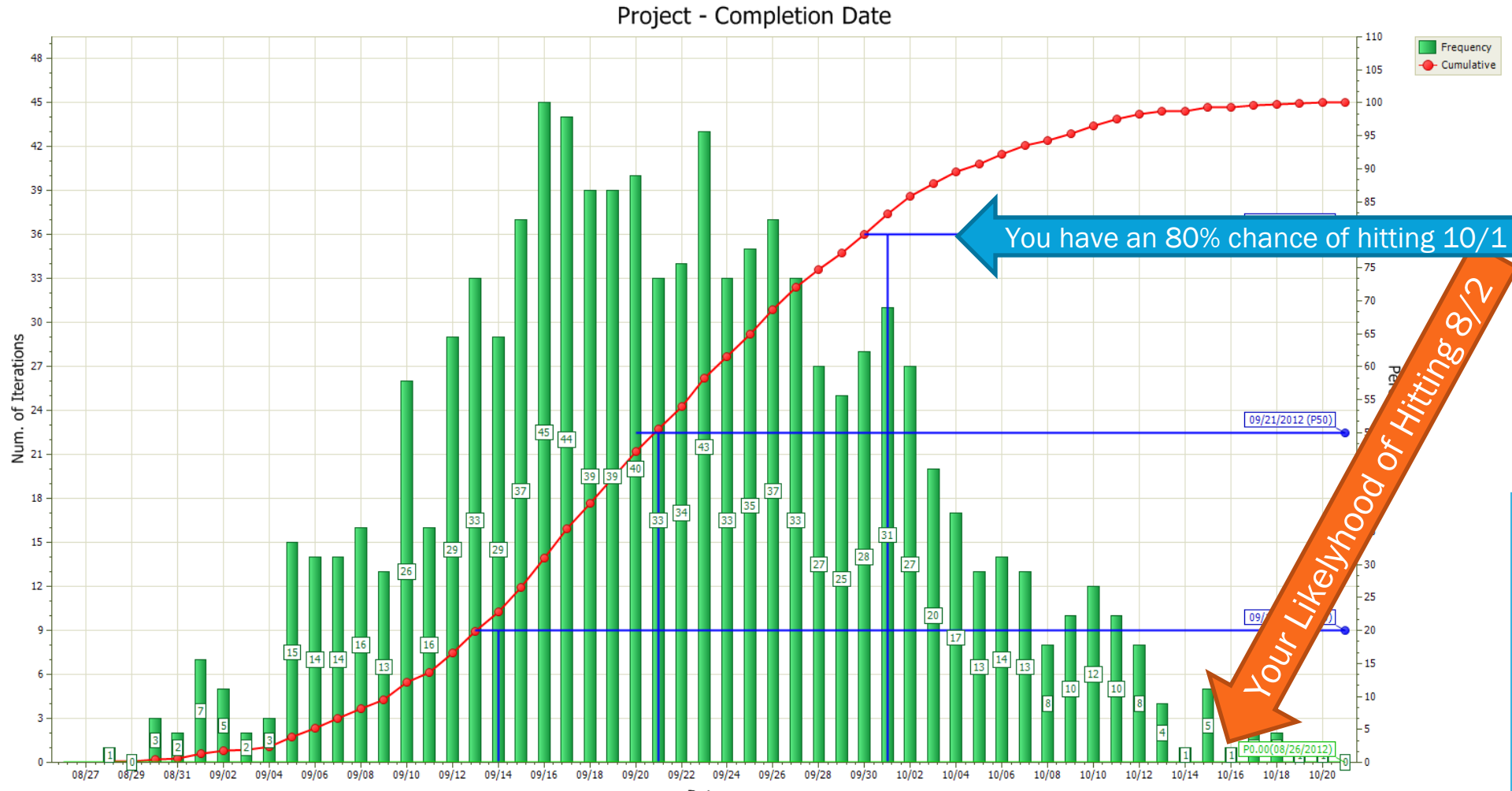
AN ILLUSTRATIVE EXAMPLE



CRITICALITY INDEXES



AFTER THE SIMULATION



BAD NEWS

Some things just don’t change over the millennium

Nobody likes the man who brings bad news.

Sophocles (496 BC - 406 BC), Antigone

And Sometimes People Just Can’t Accept Bad News…

AND NOW TO OFFSET DUMB AND DUMBER

A bit of word play…

WELL, IF YOU DO HAVE A CHANCE

How will you know what it is if you don't statistically stochastically solicit solutions?

Albeit this is an axiomatic allocution of alliteration

WHAT HAVE WE LEARNED SO FAR?

Deterministic schedules don't forecast probabilities of completion

Deterministic schedules can't generate alternate critical path's based on potential delays

Deterministic models offer project leadership less information than probabilistic models

SO WHAT'S ALL THIS HOOEY ABOUT DELAY?

There are mountain ranges of paper and oceans of ink spilled on the topic of delay analysis in construction projects. They are all based on deterministic schedules.

When you improve how you manage a project using a risked schedule model, you also need to change the way you look at delay.

IS IT EVEN REASONABLE?

When a contractor delivers a deterministic schedule on a multiyear project is it reasonable to expect the project to go as planned?

Every single activity starts on the early date forecasted in the deterministic schedule leading inevitably to schedule completion on the deterministic date…

WOULDN'T IT MAKE MORE SENSE?

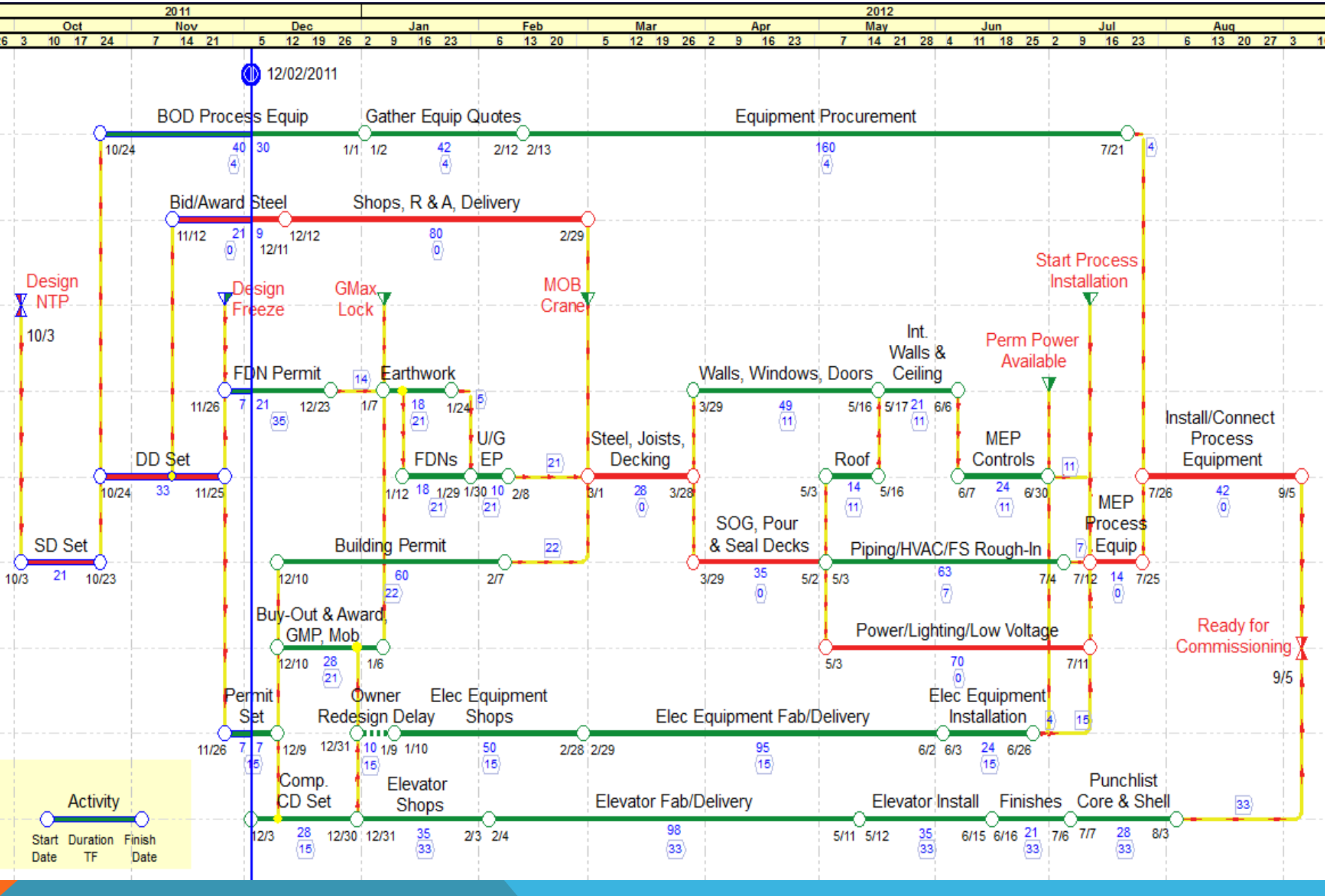
To statistically forecast the probability of completion dates

Agree on a probability and date combination for the contract?

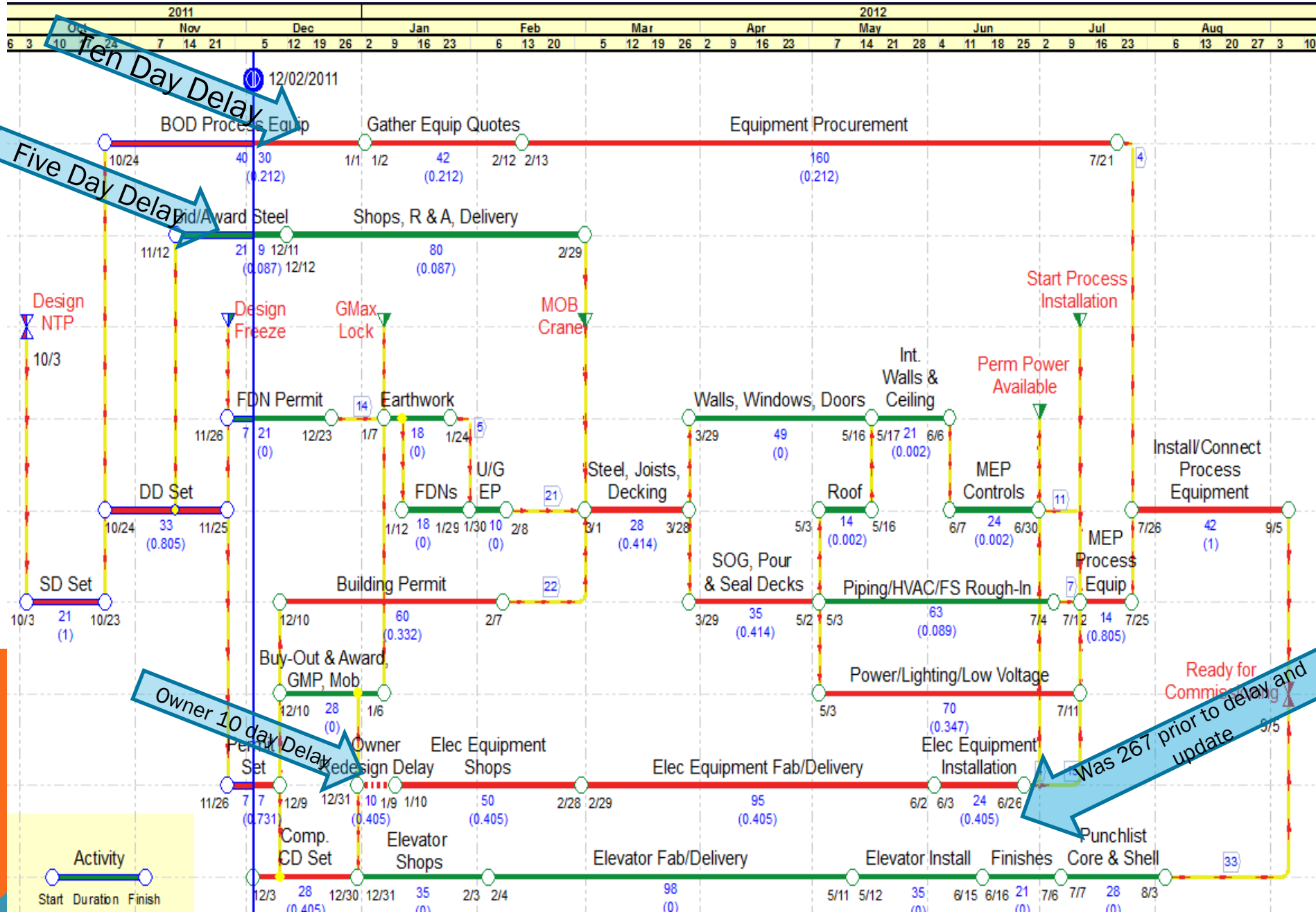
Measure how the model evolves over the life of the project?

Adjust the contractual date and responsibility based on the evolving model?

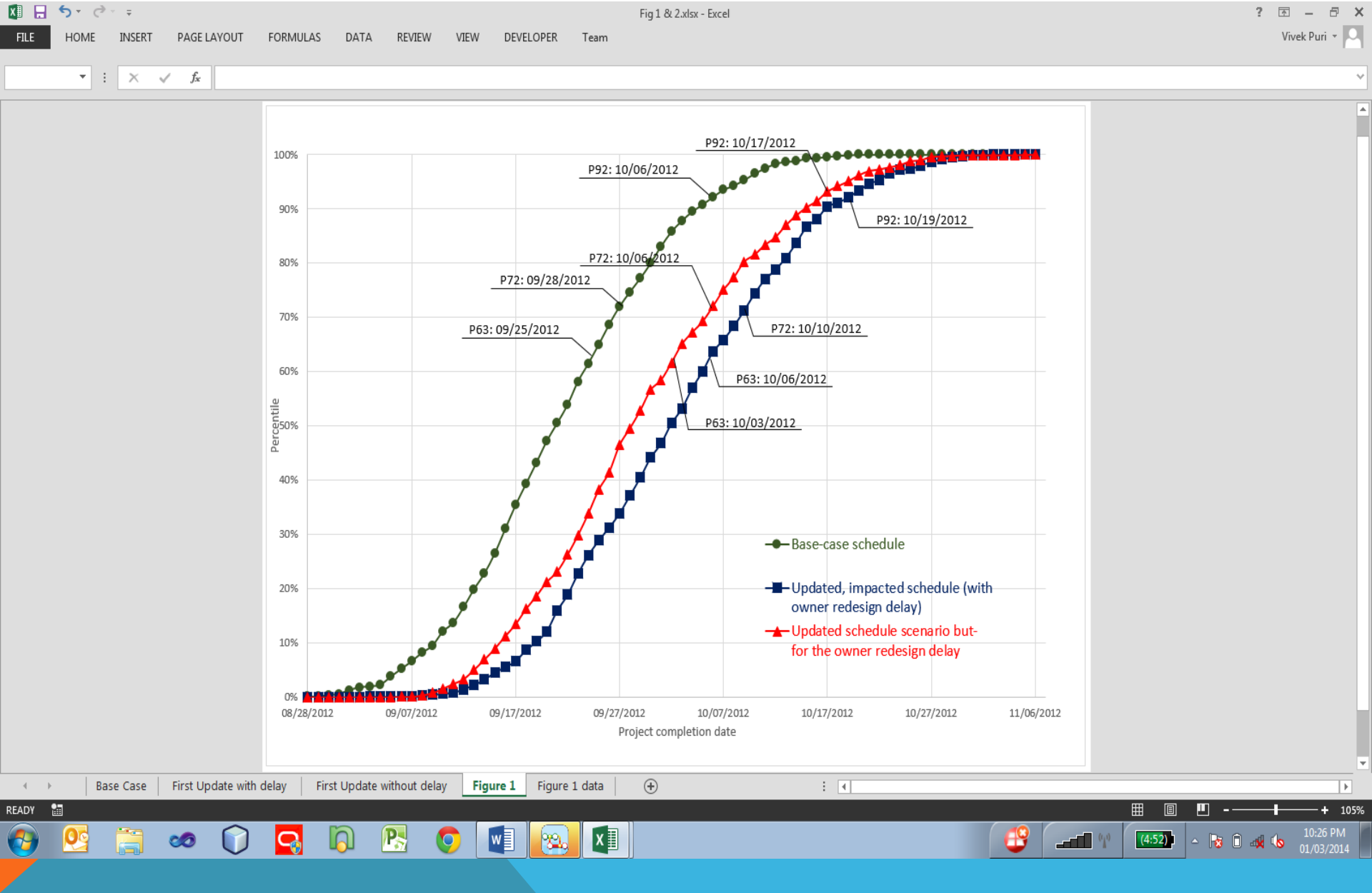
APPLICATION OF DELAY IN RISKED SCHEDULES



PROGRESSED RISKED IMPACTED SCHEDULE



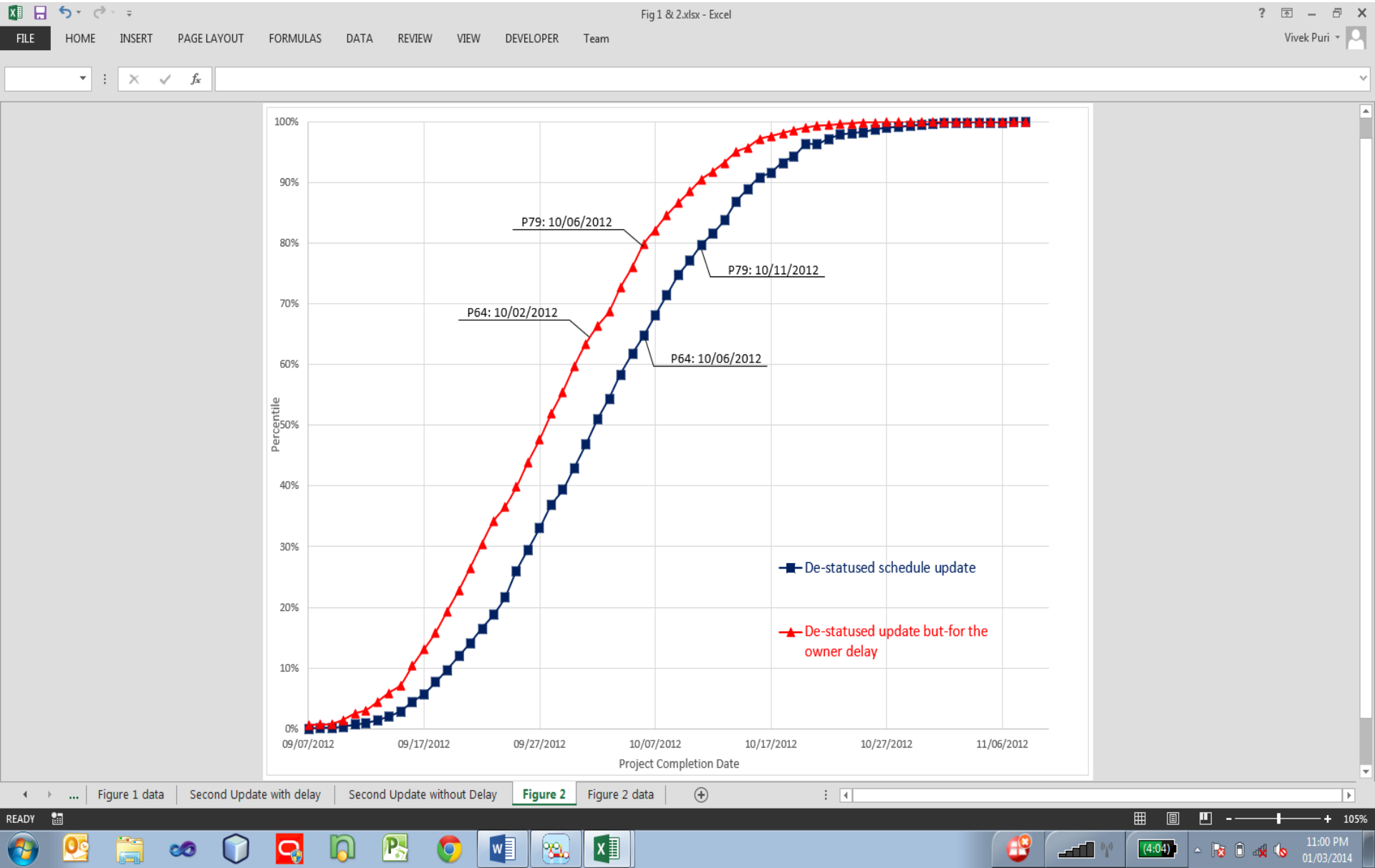
COMPARING SCENARIOS



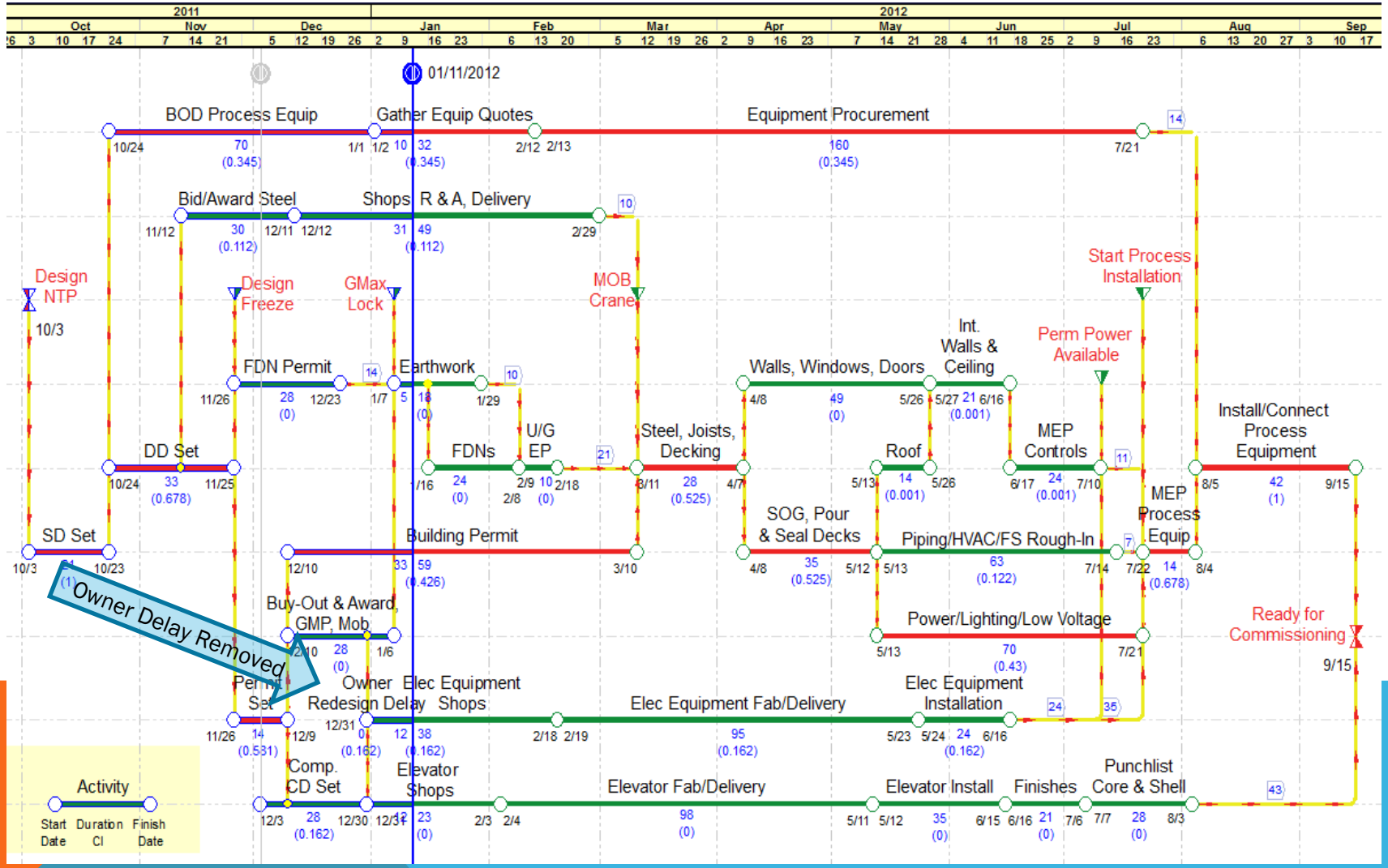
TABULAR SENARIO COMPARISON

Scenario	Deterministic Completion	Required Completion		Update Completion Date Corresponding to P72
		Date	Percentile	
Base case	08-26-2012	10-06-2012	92%	N/A
Update with the delay	09-05-2012	10-06-2012	63%	10-10-2012
Update but-for the delay	09-05-2012	10-06-2012	72%	10-06-2012

ACTUALIZING THE LIKELY IMPACT ON COMPLETION



DE-STATUSED UPDATED SCHEDULE BUT-FOR THE ACTUALIZED OWNER DELAY



NEW RULES FOR A NEW DAY

The likely impact on completion from any delay is the interval between the required completion date and the date in the impacted schedule completion distribution function that corresponds to the probability of completing on time on a *but-for* schedule scenario that removes the delay.

Time impact analysis and segmented collapsed as-built analysis protocols are offered to measure delay when a delay actualizes, based on progress through the date when the delay concludes.

Updated risk profiles (including duration ranging), contemporary with the delay at issue, may be added to the schedule along with the delay. Provided; the additions do not impact the same path, they are clearly independent, and patently unlikely to artificially amplify the impact of the delay.

WHAT IS TO BE GAINED?

The principles outlined allow the project team to predict delay based on *then-existing* criticality indices rather than on final as-built criticality.

Relative to the likely impact of a contractor delay on completion, the following two corollaries stem from these delay principles.

- First, in conventional scheduling, withholding liquidated damages in anticipation of late completion should be premised on a risk assessment that demonstrates that the contractor delay impacts an activity with a *then-existing* high criticality index.

- Second, when the schedule is managed based on completion risk, absent related action to recover schedule, withholding liquidated damages in anticipation of late completion entails a showing of continuing or increasing criticality indices along the delay-impacted path as the project progresses.

DELAY RISK ANALYSES

The *but-for* analysis comparing the states with and without a delay risk equally applies to determining the impact on completion risk of a prime risk, duration distribution change, and any other schedule risk.

THANK YOU!

Questions?